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File: USPT

Jul 5, 1994

US-PAT-NO: 5326659

DOCUMENT-IDENTIFIER: US 5326659 A

TITLE: Method for making masks

DATE-ISSUED: July 5, 1994

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Liu; Yong	Berkeley	CA		
Zakhor; Avidesh	Berkeley	CA		
Neureuther; Andrew	Berkeley	CA		

## ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE	CODE
Regents of the University of California	Oakland	CA				02

APPL-NO: 07/ 847757 [PALM]

DATE FILED: March 5, 1992

INT-CL: [05] G03F 9/00

US-CL-ISSUED: 430/5; 430/320, 430/321, 395/800

US-CL-CURRENT: 430/5; 430/320, 430/321

FIELD-OF-SEARCH: 430/5, 430/320, 430/321, 395/800

PRIOR-ART-DISCLOSED:

## U.S. PATENT DOCUMENTS

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PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<input type="checkbox"/> <u>4593351</u>	June 1986	Hong et al.	395/800

## OTHER PUBLICATIONS

SPIE vol. 1264 Optical/Laser Microlithography III (1990), article entitled "Optimal Binary Image Design for Optical Lithography," by Yong Liu, et al., pp. 401-412.

Heidelberg Colloquium on Glassy Dynamics and Optimization, Berlin, 1987, entitled "A Pedestrian Review of the Theory and Application of the Simulated Annealing Algorithm," by Emile H. L. Aarts, et al., pp. 288-306.

Proceedings of 24th Conference on Decision and Control, Ft. Lauderdale, Florida, Dec. 1985, entitled "A Tutorial Survey of Theory and Applications of Simulated Annealing," by Bruce Hajek.

Science, May 13, 1983, vol. 220, No. 4598, pp. 339-348, article entitled "Optimization by Simulated Annealing," by S. Kirkpatrick, et al.

Proceedings of 24th Conference on Decision and Control, Ft. Lauderdale, Florida, Dec. 1985, article entitled "Convergence and Finite-Time Behavior of Simulated Annealing," by Debasis Mitra, et al.

ART-UNIT: 157

PRIMARY-EXAMINER: McCamish; Marion E.

ASSISTANT-EXAMINER: Chapman; Mark A.

ATTY-AGENT-FIRM: Ware and Freidenrich

ABSTRACT:

A method for making a mask for optical lithography or other projection printing, wherein the mask is represented by a mask pattern, is disclosed herein. The mask provides a substantially binary output image on the surface of a wafer as light is applied to the mask. Light passes through the mask and onto a wafer at varying intensities, such intensities represented by output intensity values, the threshold values of which produce output images within predetermined constraints. The method includes the steps of defining sampling points which are representative of the binary output image. These sampling points are used in defining local objective functions, which are combined to give a total objective function. The present invention further includes the steps of adjusting the mask pattern to provide for minimization by optimization of the objective function, transferring the mask pattern to a mask generating machine to generate a mask, and generating a mask. Moreover, the present invention includes the step of providing an output image which is focused on a plurality of optical planes. Furthermore, the present invention includes the step isolating three of the plurality of optical planes so that their output intensity is optimized at these planes, thereby producing a focusing plane shift at the center focal plane as well as producing an extended depth of focus.

11 Claims, 39 Drawing figures



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